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Full length Research paper

A relationship between food crop production and incidence of malaria in the Ejisu-Juaben

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Malaria disease is a widespread problem in tropical countries. Recent publications have pointed to a correlation between enhanced agricultural activities and increasing prevalence of the disease. This paper therefore examined the relationship between food crop production and incidence of malaria in the Ejisu-Juaben Municipality of the Ashanti Region of Ghana. Ninety-two percent of sampled respondents had reported malaria cases in the 2010 major season. Out of these reported cases, 53.3% were female farmers. Chi-square tests of independence showed statistically significant association between education and measures adopted to control malaria. Self – medication was observed among respondents in the face of malaria symptoms. During periods of malaria incapacitation, 90.2% of affected farmers refrained from farm work. This threatened household food security and resulted in reduction in farm revenue. Average seasonal losses attributable to malaria incidence was estimated at GH¢126 ($66.67). The study recommended that efforts should be focused on malaria education during the second and third quarters of the year when malaria incidence is most prevalent.

Key words: Malaria, incapacitation, Kendall's coefficient, Ejisu-Juaben, Ghana.

INTRODUCTION

Malaria is a major contributor to poor public health and a leading cause of deaths and diseases in sub-Saharan Africa. At least 300 million cases of malaria are estimated to be reported each year globally resulting in over one million deaths. About 90% of malarial deaths occur in Africa with young children especially those under the age of five suffering the most mortality (WHO, 2008). Malaria also accounts for a high number of adult morbidity in endemic areas. Ghana's Ministry of Health and the national malaria control programme reported 2.8 million cases of malaria in 2002 and attributed 44% of out-patient clinical visits to malaria disease (Adams et al., 2004). The November 5th 2005 edition of the Daily Graphic also reported an estimated 17,000 deaths per year from malaria in Ghana.

Malaria has a negative impact on annual gross national product and up to 25% reduction in household income can be attributed to malaria control and treatment (Senzanje et al., 2002). Poor health as a result of malaria disease leads to incapacitation of the economically active population, reduces the capacity of labour force to work, affects the quality and quantity of available labour and decreases overall productivity (Asenso-Okyere et al., 2009). Thus, productive time lost and income lost to disease treatment and control, constitute some of the economically important effects of morbidity due to

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malaria disease.

Acquisition and diffusion of agricultural knowledge is also affected by malaria especially in cases where it leads to mortality. According to Asenso-Okyere et al., (2009), in cases of mortality, supply of labour is affected in addition to loss of farming knowledge.

Asenso-Okyere et al. (2009) further observed that risk of malaria transmission in malaria endemic areas increased with increasing levels of agricultural activities. Provision of irrigation water for agricultural activities through dams, reservoirs, bore-holes among others, creates favourable environments for mosquito activity all year long (Appawu et al., 2004; Yasuoka and Levins, 2007).

Studies in Eastern Ethiopia point to a correlation between type of crop grown and malaria incidence. Kebede et al. (2005) showed that maize pollen provides nutrition for larval mosquitoes. Dried leaves which fall and collect rain water, along with swampy areas reserved for rice cultivation have been shown to provide fertile grounds for mosquito breeding (Oladepo et al., 2010).

The correlation between agricultural activities and malaria incidence necessitated this study to identify the relationship between food crop production and malaria in the Ejisu-Juaben Municipality in the Ashanti Region. Specifically, the study sought to determine the period of the year when the prevalence rate of malaria amongst food crop farmers is highest, identify the effect of malaria incapacitation on farming activities, determine the coping strategies employed by farmers to reduce the effect of malaria and their relation with education, quantify seasonal losses attributable to malaria, and determine farm level activities most commonly affected by malaria incidence as perceived by farmers.

Hypothesis

H_0: Days of incapacitation, mode of diagnosis and coping strategies adopted are independent of education.

H_1: Days of incapacitation, mode of diagnosis and coping strategies adopted are dependent on education.

METHODOLOGY

Study area

Ejisu-Juaben Municipal is one of the 27 administrative and political Districts in the Ashanti Region of Ghana. The Municipal area covers 637.2 km^2 constituting about 10% of the Ashanti Region with Ejisu as its capital. It lies within Latitudes 1° 15' N and 1° 45' N and Longitudes 6° 15' W and 7° 00' W. Ejisu-Juaben Municipal shares boundaries with six other Districts in the Region. To the North East and North West of the Municipal are Sekyere East and Kwabre Districts respectively, to the South are Bosomtwe-Atwima-Kwanwoma and Asante-Akim South Districts, to the East is the Asante-Akim North Municipal and to the West is the Kumasi Metropolitan area.

As is the case for most parts of the middle belt in Ghana, the municipality experiences tropical rainfall (that is, bi-modal rainfall pattern and wet semi-equatorial climate). It is characterized by double maxima rainfall lasting from March to July and again from September and normally tapers off in the latter part of November. The mean annual rainfall is 1200 mm which is ideal for both major and minor season cropping. Temperatures range between 20°C in August and 32°C in March. Relative humidity is fairly moderate but quite high during rainy seasons and early mornings. The fair distribution of temperature and rainfall patterns enhances the cultivation of many food and cash crops throughout the district.

Types and sources of data

A multistage sampling technique was used to select 100 farmers for interviewing by purposively selecting four rural communities for ease of access to staple food crop farmers. Twenty-five farmers were then randomly selected using assigned random numbers from each of the selected communities. The towns selected were Essienimpong, Kwaso, Onwe and Besease.

Methods of analysis

Descriptive statistics including frequency distributions, means and percentages were employed in analysing the data obtained. Means and standard deviations were used in analysing the demographics. The Kendall's Coefficient of Concordance was employed to rank certain farm level activities/factors that were affected by malaria incidence as perceived by farmers.

Theoretical framework

Kendall's coefficient of concordance (*W*) is a measure of the level of agreement among independent Judges (*p*) assessing a given set of *n* objects. The approach of estimation employed in this study is adopted from Pierre (2005).

$$W = \frac{12S}{k^2(n^3 - n)}$$

$$S = \sum(SR)^2 - n(SR)^2$$

Where *k* = number of judges (farmers); *n* = number of problems ranked; *S* = sum of ranks; *SR* = mean of sum of ranks.

W ranges between 0 and 1, and indicates the strength of agreement; the closer to 1, the higher the level of agreement or concordance with *W* of zero signifying disagreement. For *n* > 30 the test of significance is achieved by computing the Friedman's chi-square X^2. Pierre (2005) cited Siegel and Castellan (1988: 270, 365) that $X^2 = k\ (n - 1)\ w$. He indicated that this quantity is asymptotically distributed like chi-square with (*n*−1) degrees of freedom and allows us to test *W* for statistical significance. *W* is significant if X^2cal > X^2crit at the prescribed level of significance.

The hypothesis was tested using chi-square test of independence.

RESULTS AND DISCUSSION

This study was conducted to identify the effects of malaria on activities of food crop farmers in the study area. Tables 1 and 2 show descriptive statistics of respondent farmers in the study area. The study sampled

Table 1. Descriptive statistics of respondents.

Variable	Frequency	Percentage
Gender		
Male	43	46.7
Female	49	53.3
Total	*92*	*100*
Educational level		
No formal education	28	30.4
Primary	22	23.9
Junior high school	11	12
Senior high school	28	30.4
Tertiary	3	3.3
Total	*92*	*100*

Source: Field Survey, January 2010.

Table 2. Summary statistics.

Variable	Min	Max	Mean	Std. dev.
Age(years)	27	66	46.32	9.69997
Household size	2	14	6.51	2.127
Farm size(Ha)	0.4	10	5.14	4.23
Farming experience (years)	2	20	13.76	5.106

Source: Field Survey, January 2010 (Std. dev.= Standard deviation).

Table 3. Effects of Malaria.

Variable	Frequency	Percentage
Prevalence periods		
1st quarter	16	17.4
2nd quarter	39	42.4
3rd quarter	29	31.5
4th quarter	8	8.7
Total	*92*	*100*
Mode of diagnosis		
Medical doctor	35	38
Traditional doctor	2	2.2
Self	55	59.8
Total	*92*	*100*

Source: Field Survey, January 2010.

100 farmers of which 92 had reported malaria cases in the 2010 major farming season, whist 8 had not report any malaria case indicating a high prevalence rate among food crop farmers in the district. The study therefore focused on those respondents who had reported malaria cases. About 53.3% of the reported cases were made by female farmers whilst 46.7% were by males. About seventy (69.6) percent of the respondents had received formal education with most (30.4%) attaining senior high school level of education. Respondents were on average 46 years old with about 14 years of farming experience and had an average of 7 persons per household. Majority of malaria cases during the 2010 major farming season, were reported in the 2nd and 3rd quarters of the year with the 2nd quarter recording the highest (42.4%) cases as shown in Table 3. This indicates a concentration of malaria cases during periods of peak agricultural activities under high rainfall conditions. It was also observed that respondents were well educated on the symptoms of the malaria disease. The number of respondents who diagnosed themselves of malaria and took remedial actions were 59.8%. Unfortunately, self-diagnosis and self-medication carry the risk of farmers misdiagnosing and treating themselves for malaria when they may be suffering from diseases like typhoid fever which have similar symptoms to malaria. Thirty-eight (38) percent sought qualified medical attention when they felt unwell and only 2.2% resorted to traditional healers for healthcare. These observations indicate a shift from traditional healthcare practices to modern medication.

Out of the total respondents who had malaria related problems, 90.2% refrained from farm work during the period of illness while the remaining 9.8% still carried on

Table 4. Period of staying away from farm work.

Period	Frequency	Percentage
3 days	19	20.7
1 week	21	22.8
2 weeks	26	28.3
1 month	17	18.5
Others	9	9.8
Total	*92*	*100.0*

Source: Field Survey, January 2010.

Table 5. Effect of illness on progress of farm work.

Effect on farm work	Frequency	Percentage
Ceases	45	48.9
Labourers work	35	38.0
Family works	3	3.3
Others	9	9.8
Total	*92*	*100.0*

Source: Field Survey, January 2010.

with their normal activities albeit with reduced vigour. Table 4 shows the distribution of the number of days that farmers had to stay away from work when ill. Also, 53.3% had to stay home to care for members of their household who had malaria whilst the remaining 46.7% still went about their normal activities when a household member had malaria. They attributed this to the fact that they had other family members who took care of those affected.

Effects of malaria on progress of on- farm activities

From Table 5, all but 9.8% of respondents refrained from active farm work during periods of malaria incapacitation. For most farmers (48.9%), farm work came to a total halt whilst the remaining 41.3% either used hired labour or relied on family labour for continuation of farming activities. Most of these (38%) relied on hired labour. Further Interviews revealed that each of the various alternatives had their shortfalls. Those who ceased from doing farm work altogether said they had to grapple with problems like emergence of weeds, late planting or delayed harvesting which resulted in low economic returns and household food insecurity. Those who hired labourers had to grapple with problems like labourers not working as expected and theft of farm produce. They also had to incur extra costs for labour. Those who had family labour as substitute did not have a lot of problems except that some of them did not have adequate farming knowledge. These observations confirm reports by Asenso-Okyere et al. (2009) that high rates of malaria transmission in rural farming communities usually coincided with the planting and harvesting seasons and so affect productivity.

Coping strategies adopted by farmers to reduce the effect of malaria and its relation with education

Farmers' views were sought on the strategies they used in the prevention of malaria. Identified strategies included visiting the hospital regularly, keeping clean surroundings (clearing bushes), using insecticide treated bed nets and clearing all choked gutters. Not all respondents demonstrated adequate knowledge on the subject, with responses like eating well, taking purgatives, and taking rest from work, among others. Chi-square test of independence showed that adoption of coping strategies was dependent on education and significant at 1% ($p > 0.001$). This meant that with higher levels of education, respondents were more inclined to adopt more effective or better coping strategies. This could be due to the fact that education gives a person a fair idea as to how to prevent or control malaria.

Losses due to malaria

Revenue losses due to incidence of malaria during the farming season ranged between GH¢0 and GH¢500 ($264.55) with the average loss being GH¢126 ($66.67) (std. dev. =52.428). Major factors contributing to farmers' losses in revenue were attributed to cost of medication, weed infestation of untended farms, delayed harvesting

Table 6. Perceived effect of malaria treatment on capital outlay.

Effect	Frequency	Percentage
Strongly agree	65	70.7
Agree	24	26.1
Undecided	3	3.3
Total	92	100.0

Source: Field Survey, January 2010.

Table 7. Ranking of activities mostly affected by malaria.

Farming activity	Rank total	Position	Comment
Labour	229	1	Activity most affected during incidence of malaria
Workdays	232	2	
Income	249	3	
Crop variety	471	4	
Household food security	472	5	
Labour intensive crops	519	6	
Area under cultivation	534	7	
Farm knowledge	607	8	Activity least affected during incidence of malaria

Source: Author's computations.

and cost of hired labour during periods of incapacitation. Despite the National Health Insurance Scheme (NHIS), farmers still incurred high medication bills because most preferred self-medication with off the counter drugs available at local pharmacies. A five point Likert scale was used to find out farmers' perception about the effect of malaria treatment on their capital. As shown in Table 6, majority (96.8%) of farmers agreed that cost of treatment affected their capital outlay adversely leading to reduction in total output for the season. None of the respondents disagreed with this statement.

Farm level activities/factors most commonly affected by malaria incidence as perceived by farmers

During the survey, some factors were listed for farmers to be ranked in order of those most affected with regards to malaria incidence as indicated in Table 7. From the table, the factor most affected is labour with a rank total of 229 and the factor least affected is farm knowledge. This is because according to the Kendall's Coefficient of Concordance, the factor with the least rank total is taken as the factor most affected.

Labour was perceived by farmers as the factor most affected in the incidence of malaria. From Table 5 above, it can be seen that 48.9% of the farmers said their work on the farm completely ceases when they were affected by malaria. Although 38.0% said labourers worked on the farm, they were not as productive as when the farmers themselves were around to supervise. Only 3.3% had family members working when they were taken ill. Second on the rankings was number of work days which is very obvious as the farmers were not able to go to work on those days due to incapacitation. The third was income. Combining the fact that the farmer was not able to go to the farm and spending his money on hired labour and hospital bills, income was likely to decrease. Fourth in the rankings was planting other crop varieties (mixed cropping). Farmers attributed this to the fact that they lose income and as such do not get enough money to invest in the production of different crops on the same field or plot of land. Also, they said they did not have ample energy to cultivate different crops. Household food security was perceived by the farmers as the fifth in the rank. This was attributed to the fact that input decreased in the case of malaria, resulting in low yields and as such farmers were not able to meet all their subsistence needs and were also not able to sell enough to cater for other crops they did not produce. Next were the labour intensive crops which farmers had to do away with in the case of malaria since they required a lot of energy and time input. Area under cultivation also decreased because malaria is mostly prevalent at that time of the year where the farmer is preparing his land and the farmer may either divert the resources he would use in preparing the land into treatment of malaria or may not be able to cultivate his normal land size due to incapacitation.

Table 8. Test of hypothesis.

Variable	Chi-square value	Degree of freedom	Significance level	Comments
Malaria diagnosis and education	36.041	12	0.000	Dependent
Days of incapacitation and education	106.8	16	0.000	Dependent
Coping strategies and education	9.530	4	0.049	Dependent

Lastly was loss of farm knowledge which resulted from the death of an experienced farmer or an experienced farmer who is incapacitated and had to stay away from work on the farm when he was supposed to give guidance on the farm as to how to go about work.

Assessing the degree of agreement of the farmers ranking

In order to assess whether farmers were in agreement with the order of the ranking computed above, the Kendall's Coefficient of Concordance was computed as:

$$W = \frac{S}{\frac{1}{12}k^2\left(n^3 - n\right)}$$

$$S = \sum(SR)^2 - n\left(\overline{SR}\right)^2$$

$$S = (229)^2 + (534)^2 + (232)^2 + (471)^2 + (519)^2 + (2$$

S = 1535857-
1371168 S = 164689
Therefore:

$$w = \frac{164689}{\frac{1}{2} * 92^2(8^3 - 8)}$$

$$w = \frac{164689}{355320}$$

W=0.46

Therefore Kendall's coefficient of concordance is 0.46
The value of W shows that 46% of the crop farmers were in agreement with the order of ranking of these specific factors.

Test of hypothesis of agreement

H_0: *w=0* (No significance of the order of agreement by farmers).
H_A: 0<*w≤1* (Degree of agreement of the rankings by farmers is significant).
Employing the Friedman's Chi-square:

$X^2 = k\,(n - 1)\,w$
$X^2 = 92(8-1)0.46$
$X^2 = 296$

$$X^2_{crit} = 18.5$$

From the results above, the null hypothesis is rejected in favour of the alternative that the degree of agreement of the rankings by farmers is significant. From Table 8 we reject the null hypothesis which says that malaria diagnosis, days of incapacitation and coping strategies are independent of education and confirm the alternate hypothesis.

Malaria diagnosis and education

The results show that malaria diagnosis depends on the educational background of the farmer. Therefore, the higher the farmer's educational level, the better the methods of malaria diagnosis adopted and vice versa.

Days of incapacitation and education

As the more educated farmers seek better modes of diagnosis, they are likely to spend relatively short time at home to recover thus reducing the number of days they are incapacitated. An increase in education is likely to improve the standard of living of farmers and facilitate control of malaria, hence reduction in workdays lost (Awoyemi et al., 2009).

Coping strategies and education

The more educated farmers were the better coping strategies they were likely to adopt since they would have more knowledge on the source of illness and as such would direct strategies in that direction. Also, education is likely to improve the living standards of the individual, hence better, efficient and improved strategies were utilized.

Conclusion

Farming communities in the Ejisu-Juaben Municipality experienced high levels of malaria during the 2nd and 3rd quarters of the year. Out of a total of 100 respondents, 92% had been clinically diagnosed with malaria in the 2010 major season, showing that malaria is endemic in farming communities in the municipality. More females than males reported malaria cases. Respondents were on the average 46 years old, had farming experience of about 14 years with about 7 members per household and

average farm sizes of 5 ha.

Most respondents had received some level of formal education. Farmers demonstrated adequate knowledge on malaria prevention with very few showing inadequate knowledge on the subject. There was statistically significant dependence between education and malaria coping strategies adopted. It was evident that most respondents relied on their knowledge of malarial symptoms for diagnosis and self-medication.

During periods of morbidity due to malaria disease, 90.2% of respondent farmers refrained from farm work, with the few that carried on with farm work doing so with reduced vigour. Abandonment of farms during periods of incapacitation threatened household food security, encouraged weed infestation of farms, delayed harvesting and in some cases hampered timely field preparation activities.

Losses in revenue attributable to malaria ranged between GH¢0 and GH¢500 ($264.55), with GH¢126 ($66.67) being the average loss per season. Major contributors to losses in revenue were costs of medication, cost of labour and losses due to delayed harvesting. Farmers ranked labour (quality and quantity) as the factor most affected by malaria incidence.

RECOMMENDATIONS

The study recommends intensification of malaria education during the second and third quarters of the year when malaria prevalence is at its highest. The use of insecticide-treated bed nets and insecticide sprays by farmers is also recommended.

Along with education on control and treatment of malaria, farmers should also be encouraged to promptly seek professional medical advice when they feel unwell instead of resorting to self-medication.

Farmers should be encouraged to register with the National Health Insurance Scheme to reduce costs incurred on medical treatment in times of morbidity.

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